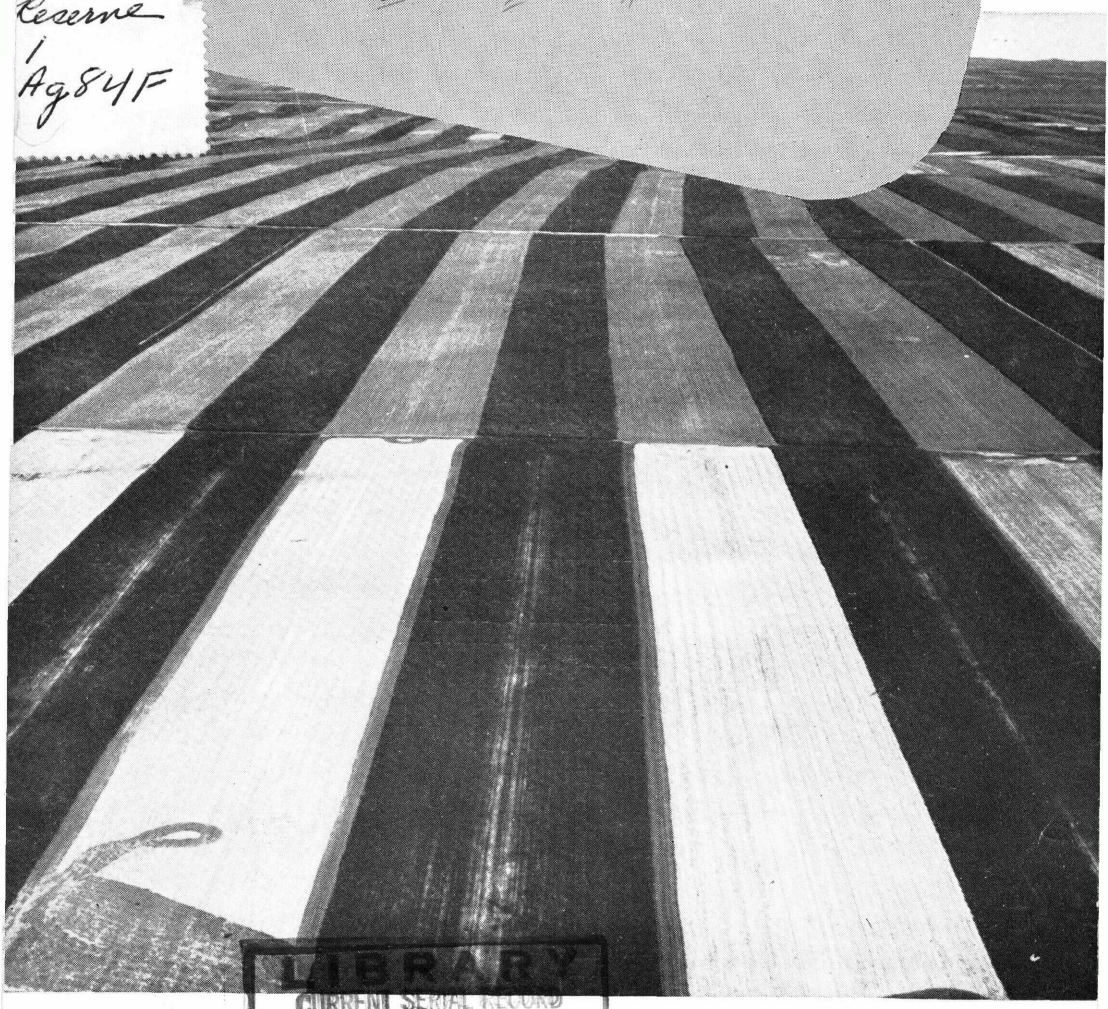
Implements and Methods of Tillage to *Control Soil Blowing* on the Northern Great Plains



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COVER ILLUSTRATION.—Stripcropping with alternate fallow and small grain is an effective practice for controlling soil blowing. The width of strips depends on the danger and severity of blowing to be expected. (Courtesy of the Montana Agricultural Experiment Station.)

WASHINGTON, D. C. Revised January 1954

IMPLEMENTS AND METHODS OF TILLAGE TO CONTROL SOIL BLOWING ON THE NORTHERN GREAT PLAINS

Prepared in Soil Management—Irrigated and Dry Land Regions, Agricultural Research Service[1] *in collaboration with the Soil Conservation Service*

THE REGION AND THE PROBLEM

Soil blowing is a serious problem in the northern Great Plains region, which includes the western three-fourths of North Dakota, South Dakota, and Nebraska, the eastern parts of Montana and Wyoming, and northeastern Colorado. The amount of damage varies greatly from year to year, because the region is subject to irregular rainfall and varying periods of high winds, which often last for 3 or 4 days.

In most years there is some injury to crops from blown soil. When winds and drought come together, soil blowing from bare cultivated land may destroy seedling crops. The surface soil may be entirely removed or left piled in drifts. Soil blown from overgrazed pastureland may be deposited on adjacent land, badly damaging crops or pastures. Highways are often made impassable by loose soil, and farmsteads may be damaged or entirely ruined. Windborne dust often causes extreme discomfort to the population of large areas and sometimes impairs the health of individuals.

Wind erosion has always been a problem in the northern Great Plains, but was not general enough in any one year to attract nationwide attention until the early thirties. Then the widespread drought, grasshopper infestations, and large areas of abandoned cultivated land made possible extensive damage from soil blowing. The high point of such damage was reached in the years 1933–35. During this period it became increasingly evident that some types of soil cannot be safely cultivated under Plains conditions. Cultural operations to check soil movement and greater rainfall that provided better ground cover eventually brought most of the land under control. During and immediately after World War II wind erosion remained at a minimum because of continued high average rainfall. However, at that time, the acreage under cultivation increased sharply as demands for foodstuffs became acute. Several million acres of sodland were broken out and planted to crops, mainly wheat. The increased acreage of land under cultivation provides the possibility of damage from soil blowing on an extensive scale if unfavorable conditions again occur and unless preventive measures are taken.

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Effective measures to control soil blowing on the northern Great Plains are relatively simple in principle. They are based on information acquired from observation and from research which was thoroughly tested during the severe drought period of the thirties. Tracts of land covered with weeds, crop residues, or clods did not blow even during this period. Land within experimental field stations generally remained undamaged except by the cutting action of soils blown in from the outside or the accumulation of such soils on station land. This was partly because fields were relatively small and soil movement did not acquire as much momentum as on wider expanses, but chiefly because land management and cultural practices at field stations were different from those of many farmers in the region. Research had made it apparent that conservation of moisture was not dependent on the fineness of the surface soil (fig. 1). It was also found that cultivation that destroyed weeds but left the surface cloddy or covered with residues was effective not only in conserving moisture but in reducing wind erosion.

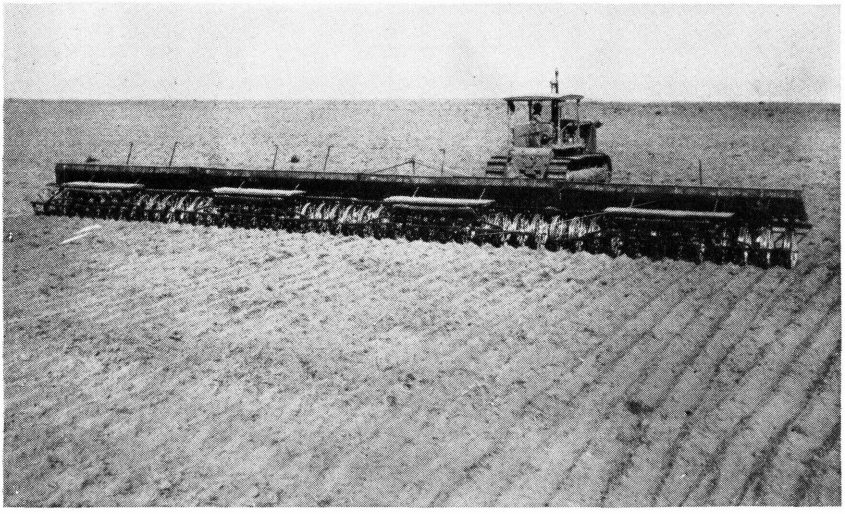

FIGURE 1.—The soil in this field is finely pulverized and without surface residues. It will blow readily if high winds occur before a plant cover is established.

SOILS

The soils of the northern Great Plains have been developed under a grass cover in a semiarid climate and are therefore broadly uniform. In detail, however, they vary greatly as to place of origin, method by which the parent soil materials were laid down, and texture, each of which has an influence on resistance to soil blowing. The soils of the northern part of Montana and those parts of North Dakota and South Dakota east of the Missouri River have developed from highly variable glaciated material. The parent soil materials of the remaining part of the region include soils formed in place, alluvial deposits along streambeds, deposits formed under water in lakes, loessial deposits formed by wind, and volcanic ash and lava. In texture the soils range

from heavy clays and adobes through silts to sandy and gravelly loams and dune sands. Most of the soils are fertile and of good texture for cultivation; the limiting factor in crop production is the uncertain rainfall.

ORGANIC MATTER AND HUMUS

The physical properties of a soil are influenced by the quantity of organic matter present and the state of its decomposition. Crop residues or organic matter in a soil have a mechanical effect in the control of soil blowing, provided they have not decayed to such an extent that they are incorporated with the soil. When residues are fresh and lie partly above the surface, they provide the maximum protection against drifting of the surface soil. As these materials decay they become less effective in checking wind erosion. For this reason they must be renewed or replaced constantly. Completely decomposed residues do not reduce soil drifting and may increase it.

RESPONSE OF SOILS TO MOISTURE

Soils differ greatly in their responses to moisture, and some of these responses are important in the control of soil blowing. Sandy soils, with larger particles and larger pore spaces, absorb moisture more readily and release it more easily than the finer grained clays, in which the pore spaces are smaller and more numerous. Because the particles are held together, soils do not blow when they are wet or even moist. On some bare sandy soils, however, soil particles detached by surface splash may start moving shortly after a rain and cause damage to newly emerged crops at a time when most of the soil surface is still wet. The finer grained soils often retain enough moisture to tide over a blow period without injury, whereas under similar conditions more sandy soils dry out enough to blow.

Most soils in the northern Plains region form a crust as they dry, especially when the drying is rapid after heavy rain. The depth and character of this crust varies with different soils. Crusts formed on the finer grained clays are usually thicker and held together more firmly than those formed on the more sandy soils. Proper tillage operations form clods from the various crusts and leave a roughened surface that resists soil blowing. Because they are more cohesive, the clods formed on the medium- to fine-grained soils usually resist wind action better than those on the sandy soils.

There are large areas of heavy clay soils in the northern Plains that are as susceptible to blowing as the lighter textured soils. When these soils dry, the body is a loose mass of granulated particles. The thin clay crust cracks, and the edges curl and are readily broken down. The fine particles blow away as dust, and the aggregates blow into great dunes like sand. Control by roughening is a very temporary measure. Such areas should be protected with a plant cover at the earliest opportunity.

Alternate freezing and thawing during the winter may make generally resistant soils fine and loose in the spring, and drifting may be serious. After such soils are wetted by spring rains, however, they again exhibit their cohesive characteristics and can again be protected from the action of wind.

EFFECT OF CULTIVATION

Some of the soils of the northern Great Plains should not be under cultivation, because they drift so easily. The sandy soils are the most subject to blowing, as they have very little cohesive quality and when bare will drift easily. It is impossible to cultivate them without pulverizing the surface. Very few or no clods are formed, and those that are formed do not last.

There are large sections in the region with soil that is fertile and light enough to be tilled easily, but also light enough to drift seriously. With proper management these soils can be controlled. The kind and time of cultivation is very important in such soils, because clods or surface crop residues can usually be maintained with the proper implements, except under unusual conditions. But, with excessive cultivation, the surface of such soils may become so fine that control is difficult.

There are other soils that drift very little, if at all, even when lying fallow over the winter. The soil particles are held together tenaciously, and common tillage practices usually are satisfactory.

PROTECTIVE COVERS

Soil blowing does not occur when the surface is protected either with growing vegetation or an adequate cover of undecayed crop residues. Soils of native grasslands seldom blow or drift, unless the cover is badly overgrazed. A thriftily growing crop of small grain also affords ample protection. Crop residues, either in the form of standing stubble or mulches left by some cultivating implements (fig. 2), are also effective in controlling soil blowing.

GRAIN CROPS

The cropped acreage in the northern Plains is largely devoted to spring grains, the greatest acreage being in wheat. A part of the spring grain is grown on fallowed land or cornland, but much of it is cropped continuously. In the eastern part of the region tillage operations in continuous cropping are done either in the fall or spring, but in the western part they are usually done in the spring.

If properly managed, continuous grain affords much protection for the surface soil, because the surface is covered most of the year either with the growing crop or stubble. Land on which cultivation starts in the spring is bare only until the crop makes growth enough to protect the surface. Consequently, there is danger of soil blowing on a large scale only in seasons when dry springs prevent early growth of the crop. Land plowed in the fall should be left rough over winter if the clod structure is tenacious. Soils that crumble quickly become subject to wind erosion and should remain in stubble over winter.

STUBBLE-MULCH FALLOW

The acreage of stubble-mulch fallow has increased because subsequent yields have been about equal to those after plowed fallow; and, on soils that are inclined to blow, the stubble-mulch method leaves stubble and trash on the surface, which serves to control drifting. Subtillage implements, duckfoot cultivators, or one-ways (one-way

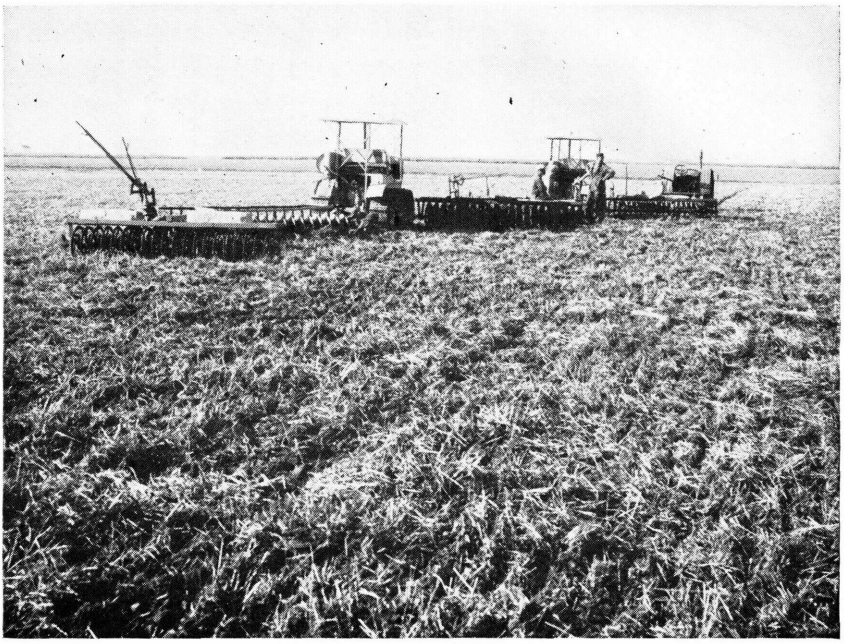

FIGURE 2.—Grain stubble partially worked into the surface soil by one-ways (one-way disks) used in combination with packers. Such residues resist soil blowing.

disks) are usually substituted for the plow for the initial tillage. These implements operate at a lower cost per acre than a plow and and have the added advantage of requiring less time to cover a given acreage. For later cultivations, the duckfoot cultivator, undercutting blades or sweeps, and the rotary-rod weeder are better than the one-way, as they do not destroy the stubble or pulverize the surface soil.

TILLAGE IMPLEMENTS

The resistance of soil to blowing is in a large measure dependent on the condition of the surface. The selection and proper use of tillage implements are therefore extremely important in the control of soil blowing. Implements for cultivation vary widely in their effect on the soil. Some leave it pulverized, and others form clods; some completely turn the surface, while others stir the topsoil but do not turn it under.

MOLDBOARD AND DISK PLOWS

Recent investigations have shown that plowing is seldom necessary under semiarid conditions such as those in the northern Great Plains. Implements developed specifically for those conditions are to a large degree replacing the plow. Despite this, the plow still remains important on many soils that require thorough, general-purpose cultivation, since it turns under plant residues and trash, improves the tilth, and prepares the foundation for a good seedbed. Plowing, however, leaves no trash on the surface, and in some areas a trash cover is almost imperative.

Moldboard plows usually leave surfaces somewhat rough and loose. The degree of roughness depends on the character of the soil and its moisture content when plowed. Because of the friction on the moldboard and the general pushing effect as the soil is turned, there is less pulverizing than with many other cultivating implements. The turning action rearranges and loosens the soil so that air circulates readily. Soils that are plowed when they are moist usually have coarse, lumpy, or cloddy surfaces when they dry. Heavy, cohesive soils form a large number of clods if plowed when moist. There is, however, danger of plowing the heavy soils while so wet that the entire plowed layer may bake and become a consolidated, lumpy mass. Sandy soils can usually be plowed when they have a high water content with little danger of severe baking.

Spring plowing for spring-sown small grains has increased in importance in recent years. Unit combinations of implements make it possible to plow, work down the soil, and seed in a single operation. Use of such combinations speeds planting and does away with the dried-out seedbeds and delayed germination that often result from use of separate implements. The operation is somewhat more expensive than surface tillage but provides better weed control. Plowing buries weed seeds deep enough so that few weeds are able to emerge quickly and compete with the young grain plants.

The depth of plowing may have an effect on soil blowing, depending on the character of the soil. When the surface is light and the subsurface rather heavy, an occasional plowing that is deep enough to bring up some of the clay may be an advantage, because the clay will form more clods than the lighter surface soil. Subsoils in the region are ordinarily somewhat fertile, so that fertility is not greatly decreased when they are mixed with the surface soil. If the subsoil is as light or lighter than the surface soil, there is no advantage in deeper plowing, except to bring to the surface lumps and clods formed by consolidation below the zone of shallower cultivation.

The disk plow is sometimes used in place of the moldboard plow for plowing hard, dry soils (fig. 3). It can be used safely for fall plowing on dry soils that do not pulverize in winter by freezing and thawing. The clods break easily when moist in the spring, but become hard when dry and are difficult to work into a seedbed. The disk plow can also be used without choking where there is stubble and trash and in some soils that will not scour or clear when the moldboard is used. However, it has more of a pulverizing effect on soil that is moist and in condition for plowing. The pulverizing effect of the disk plow is a disadvantage on some soils that disintegrate during the winter and blow easily when the spring is dry and windy.

LISTER

The lister is not in general use in the northern Great Plains. It can, however, be used for planting corn or for emergency tillage of land to prevent blowing. Because listing leaves the land ridged and rougher than plowing, it affords greater protection against blowing. Listing as an emergency measure may be done with furrows closely spaced or with furrows 2 rods or more apart (fig. 4), depending on the severity of conditions, the power available, and the length of time it is estimated that protection may be required. When the furrows are spaced

FIGURE 3.—Disk plows are effective in plowing hard, dry soils. They should not be used on soils that crumble easily.

FIGURE 4.—Strip listing (listing one or two furrows at intervals of 2 rods or more) provides protection against soil blowing for a short time or when only moderate protection is needed.

at intervals, the operation is known as strip listing. The purpose of strip listing is to trap the soil that is moving along the surface and prevent it from gathering volume and accelerating the erosion process. If the furrows fill up, the operation can be repeated. Strip listing is often employed in the attempt to save a crop of grain, especially winter wheat, that does not have enough growth to protect itself.

Contour listing (fig. 5) not only protects against soil blowing but conserves water by checking runoff. The increased water supply may

FIGURE 5.—Contour listing can be utilized to give temporary protection from soil blowing. The contoured furrows also serve to hold rainfall and prevent runoff.

promote a greater growth of crop which in itself will protect the soil.

An attachment developed for the lister throws up dams at intervals in the furrows. The lister so equipped is known as a basin lister. It was originally hoped that this implement would make contour listing unnecessary. In practice, however, it has been found that the dams will not hold during heavy rains unless the work is done approximately on the contour.

DISK HARROW

The disk harrow, commonly called a disk, has not proved to be generally adapted for the cultivation of bare or unprotected soils of the northern Plains. In fact, its use is hazardous on soils that tend to blow, because it pulverizes the surface soil, does not form clods, and leaves a smooth surface that drifts easily. In addition, it is not very effective in eradicating weeds. However, the implement can be used as a packer after a plow if the disks are set straight. It can also be used to cultivate stubble land, but only the heavier tractor types will penetrate dry soils. The offset disk (fig. 6) does a good job of preparing a seedbed and leaves the surface level, but also pulverizes surface soil.

SPIKE-TOOTH HARROW

The spike-tooth harrow pulverizes and smooths the surface soil, and for this reason is rather dangerous to use unless the soil is fairly moist. It can be used in the preparation of a seedbed in early spring, but should not be used on fallow land during the summer or on soil that is already fine and in condition to blow.

SPRING-TOOTH HARROW

The spring-tooth harrow (fig. 7) is popular in many parts of the northern Great Plains, especially for cultivating clean summer fallow. This implement has a tendency to bring clods and a small amount of

FIGURE 6.—An offset disk is excellent for killing weeds and for working heavy trash into the soil. It tends to pulverize soils, however, and should not be used in light soils or when soils are likely to blow.

FIGURE 7.—A heavy spring-tooth harrow is primarily useful for killing small weeds but is of little value for cultivating to control soil blowing.

trash to the surface, but it cannot be used if residues are present in large quantities, as they gather on the teeth and interfere with its operation. This implement is economical to use and will clean land of small weeds, but it is not effective when they have attained much size. It leaves the surface loose as deep as it cultivates, but this depth is easily regulated. Its greatest value is for killing small weeds and volunteer grain just prior to seeding.

FIGURE 8.—The duckfoot cultivator is effective in bringing clods and trash to the surface on summer-fallowed land or on land being prepared for wheat.

DUCKFOOT OR FIELD CULTIVATOR

The duckfoot or field cultivator (fig. 8) is used quite generally on the northern Great Plains both for the cultivation of summer fallow and for seedbed preparation. It leaves a ridged surface that is desirable for the control of blowing. The surface soil is loosened for 3 or 4 inches and is usually in excellent condition to absorb heavy rains with little tendency for surface puddling. Shovels are generally arranged to allow adequate clearance, and the cultivator can therefore be used on soils where there is some trash. The implement works well in wheat stubble without clogging if rear gangs are extended about a foot. Objections to its use are that the cultivated surface soil may dry out, and that the implement may not entirely eradicate weeds. It is rather expensive to operate, because of the necessity of replacing the shovels, which wear rapidly.

COMMON ROW CULTIVATOR

The common row cultivator can be used effectively under many conditions to check blowing that has not yet become severe or to provide limited protection against possible blowing. It is especially useful for temporarily roughening a smooth, unprotected surface soil, such as that from which a row crop has been closely harvested or where a plowed or otherwise cultivated field has been reduced to a blow condition by weathering or beating rains. When used for this purpose,

it is common practice to remove all but one shovel from each beam. Such cultivation is effective only when the shovels bring to the surface lumps and clods or moist soil that will form clods on drying.

Cultivators fitted with only one shovel on each beam can also be used in fields sown to small grains that have not developed a protective cover. When such cultivation is necessary, the thinning that is done is likely to be beneficial rather than destructive.

ONE-WAY

The one-way, or vertical disk, also known as the "gold digger" and "wheatland plow" is equipped with large disks that are set fairly close together. The entire surface soil is moved by this implement and left in a much looser condition than after a plow. The one-way pulverizes the soil about as much as other disks, but is more effective in killing weeds. Because of its weight, it is especially adapted for use on dry, hard ground immediately after harvest of small grains. It can be used where there is a heavy stubble or other plant growth. The rotary action of the disks leaves such organic material on or near the surface, where it serves as a good protective covering.

Without trash to provide surface protection, the one-way leaves the soil so fine that it is in condition to blow. Every additional operation with this implement greatly reduces the quantity of trash on the surface and renders the soil more susceptible to blowing. Use of the one-way should therefore be limited to one operation, particularly when summer-fallowing those soils that are subject to wind erosion.

The one-way is a very adaptable implement. The angle and speed of operation determine how deep it will penetrate and how much of the residue will be left on the surface. It can be made into an emergency tillage implement doing work resembling that of a lister by removing some of the disks (fig. 9).

A modification of the one-way called the eccentric one-way is being used in some areas. Every other disk of an ordinary one-way is replaced by a disk 2 inches larger in diameter and with the gang bolt-hole 2 inches off center. This implement leaves the surface soil pitted, thus holding some water that might otherwise be lost by runoff (fig. 10).

FURROW DRILL

There are several types of furrow drills, but they all leave a ridged surface that resists the action of wind much better than the smoother surface left by ordinary shoe and disk drills. The furrow drill is used mostly for planting winter wheat, as it gives added winter protection to the plants and aids in the control of soil blowing, but it is also used for spring wheat. One type is equipped with large shovels that cultivate the entire surface, thus eliminating all weed growth at the time of seeding. This type of furrow drill is sometimes used as a duckfoot cultivator. It is effective for emergency cultivation to check soil that has started to drift. When used on the contour it also serves to retain water on the field.

ROTARY ROD WEEDER

There are several different makes of rotary-rod weeders, but all operate on the same principle. The tilling rod, which may be square, oblong, or round, runs 2 inches or more below the surface, the depth

FIGURE 9.—A one-way with several disks removed may be used for emergency tillage to prevent soil blowing.

depending on the condition of the soil. The rod revolves slowly, turning upward as it advances, which tends to keep the rod pulling downward in the soil and to deposit coarse material, including clods, on the surface, with the fine material below (fig. 11). The implement

FIGURE 10.—This stubble field has been cultivated with an eccentric one-way disk. The implement leaves pits that help in preventing runoff.

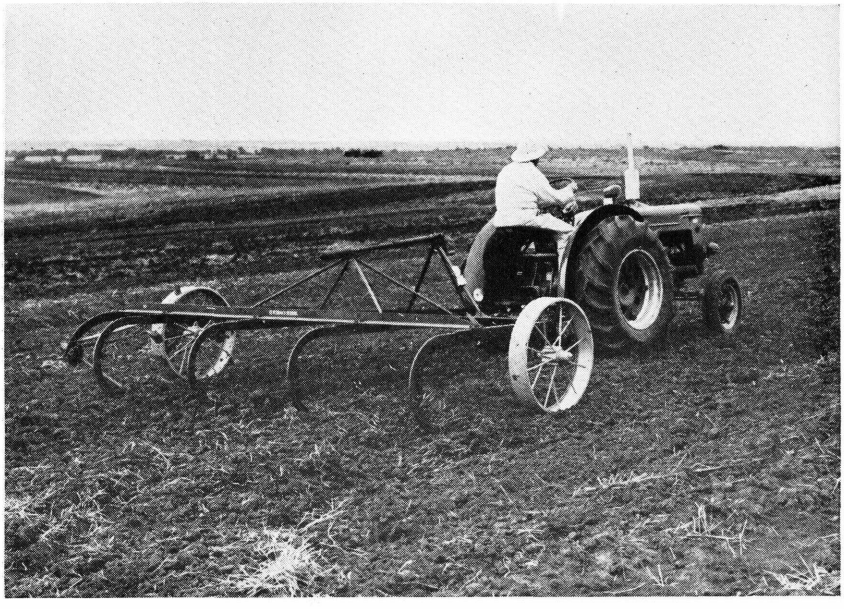

FIGURE 11.—The rotary-rod weeder leaves clods and crop residues on the surface.

operates best in fairly loose soil without abrupt depressions or ridges. It is not adapted to use in stony soils but can be made to penetrate rather hard ground by using a bar with attached points below the revolving rod. It clears itself well and can be used where there is trash or fairly heavy weed growth. It is very effective in killing weeds, as

most of them are deposited on the surface. It packs the soil to some extent just below the surface and is an excellent tool for the last tillage operation before seeding small grain and for summer cultivation of fallow. Few summer cultivations of land being fallowed are usually required. Unless it is used excessively, the rod weeder leaves a cloddy surface that is resistant to the action of wind. Its continued use may, however, overpack fine soils and make them impervious to rain.

CHISEL

The chisel is an implement with heavy narrow-curved arms or shanks. It is used chiefly to break up hard soil and when used for this purpose leaves a surface that is rough and resistant to runoff and erosion during the first few rains (fig. 12). Chisels can be made to penetrate very deeply, but cultivation below ordinary depths of plowing requires much power and is seldom profitable under dryland conditions.

SUBTILLAGE IMPLEMENTS

There are many types of subtillage, or undercutting, implements, but the general principle of all is to kill weeds and other unwanted vegetation while retaining the residue on the surface to facilitate penetration of rains and to prevent erosion. They are designed to operate parallel with the surface and to undercut land with the least disturbance of surface residues consistent with weed control. The better designed implements can be adjusted to run at controlled depths.

FIGURE 12.—Chisels are especially useful for cultivating hard soils. They bring up clods but do not entirely cover plant residues, thus leaving the surface in condition to resist blowing.

Subtillage implements have been improved since their introduction to provide sturdier construction, greater clearance, better means of handling trash, and better penetration and depth control. According to the Soil Conservation Service, the basic requirements for a subtillage implement are that it should (1) be capable of operating at controlled and uniform depths; (2) be equipped with rolling coulters to cut residues and weeds ahead of the sweeps and thus prevent clogging; (3) have adequate weight and strength for penetration and operation under unfavorable soil conditions; and (4) be able to kill weeds and volunteer plants. It has been found that sweep machines operate best when the cutting edge of the whole sweep is at a uniform depth. Tilting the points down to hold the sweeps in the ground requires greater tractor power and usually results in inferior work.

The types of undercutting implements are numerous, but in general they may be classified into four groups: (1) blade implements; (2) implements resembling duckfoot cultivators, (3) blade or sweep attachments for listers or plows, and (4) combination implements.

(1) *Blade implements.*—The straight-bladed implement shown in figure 13 is typical of implements in this group, which are generally used for initial tillage on stubble land. Such tillage loosens the soil and makes later use of other types of tools easier. For cultivation to kill weeds, the straight blade is replaced by "V" or "sweep" blades that can be attached to the same standards. Two overlapping weeder blades usually take the place of a straight blade.

(2) *Implements resembling duckfoot cultivators.*—Implements in this group differ from duckfoot cultivators in that the shovels are fewer and wider, shanks are longer to give greater clearance, and in most cases rolling coulters operate in front of each shovel to prevent clogging. An implement of this type is shown in figure 14. The

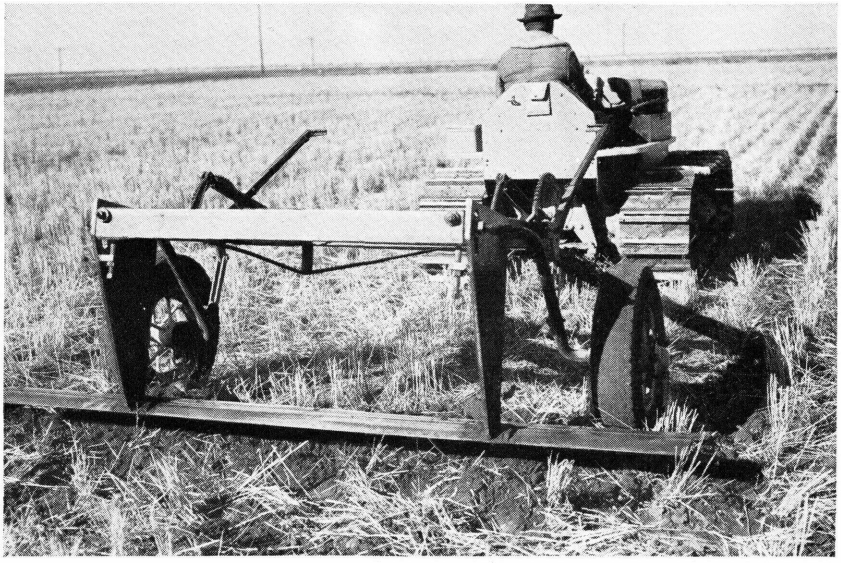

FIGURE 13.—Straight-bladed subtillage implements raise the soil, roughen the surface, and leave most of the residues aboveground.

FIGURE 14.—A subtillage implement with 30-inch sweeps adapted from a duckfoot cultivator.

relatively small number of shanks reduces the surface disturbance, and the spacing of the shovels permits them to operate in heavy stubble without clogging. The most effective included angle of sweep blades is about 60°. Sweep-bladed implements lift the soil far less than the straight-bladed implements. Under severe conditions, weights are added to hold the blades in the ground. Adjustable hitches for running the sweeps level at different depths are commonly available. Improvements in sweep machines have made them highly effective and have greatly increased the range of conditions under which they can be used successfully. Early implements did not have the structural strength to operate in hard soil, but more recent models have been sturdy and the increased weight has helped their penetration.

(3) *Blade or sweep attachments for listers or plows.*—Listers and plows can be utilized as chisels or subtillage implements by replacing the moldboards with chisel or sweep blades (fig. 15). Such blades make it possible to perform subtillage operations without the expense of purchasing new and special equipment. When equipped with chisels instead of sweeps, these implements can be used for emergency tillage of land that is too dry to list or plow, such as dry row-crop land that has started to blow.

(4) *Combination implements.*—Implements in this group are not exclusively subtillage implements, but are adapted to subtillage or mulch-farming systems. One of the most widely used is equipped with chisel shanks that are used for initial loosening of the soil. For later cultivations, removable, vertically adjustable sweep blades can be attached to the chisel shanks. The sweeps of this machine are intermediate in width between those of the duckfoot cultivator and the typical sweep machine, like the one shown in figure 14. This type of

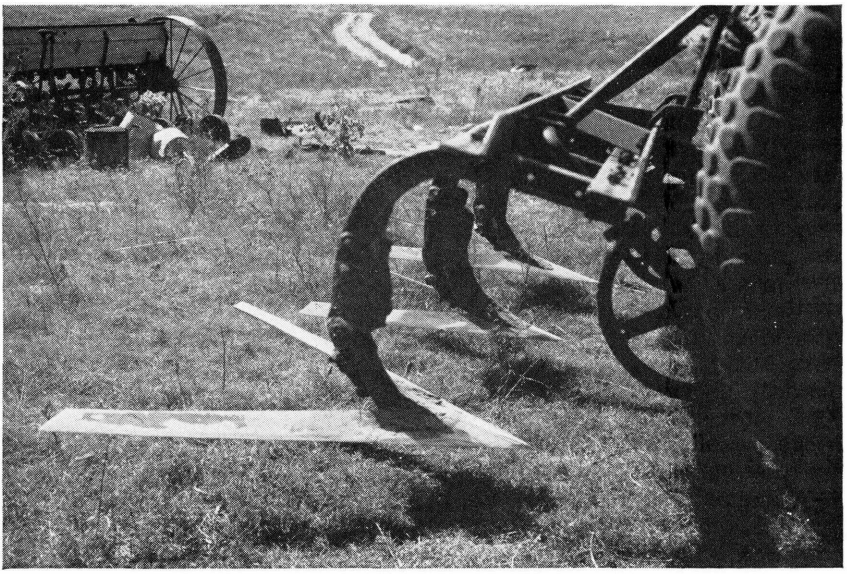

FIGURE 15.—Large sweep blades have been attached to this three-row lister frame to convert it to a subtillage implement.

implement is adapted to a rather wide range of conditions and has gained greatly in popularity in recent years.

Subtillage implements are now used chiefly in combination with other implements. On hard soils when the stubble is heavy the first tillage may be with a one-way or some other implement that breaks down the stubble and partially incorporates it in the surface soil. This makes subsequent operations with subtillage implements easier, and the quantity of stubble left on the surface will usually be enough for erosion control. Light stubble can be handled completely and satisfactorily with subtillage implements. Loose seedbeds may be improved by using the rod weeder for the last tillage operation before seeding, or by pulling some packing implement such as a treader, a packer, or a disk set straight, behind the subtiller.

Many implement companies now manufacture tool-bar attachments for tractors to which a wide range of shovels and sweeps, including those that are used specifically for subtillage, can be attached. Drills especially adapted to seeding grain in stubble mulches are also available.

INFLUENCE OF PRECEDING CROP AND TILLAGE METHOD

Both the nature of preceding crop and of the tillage that follows have an effect on the drifting of soils. Row crops are especially liable to blowing because they often require cultivation to kill weeds when soils are dry and easily pulverized.

BEANS

Several experiment stations report that beanfields are very susceptible to blowing and difficult to restore to a stable condition. Time of cultivation and method of harvesting required are the chief con-

tributing factors. The crop is cultivated in midsummer when the soil is usually dry, and it is harvested late in the summer by means of knives that cut the plants off beneath the surface. Little binding material is left in the soil, and there is no crop residue on the surface, which is left in a pulverized condition. In western Nebraska and parts of Wyoming a winter cover crop seeded early has provided effective wind-erosion control. Other suggested remedies are to grow beans in narrow strips with stubble or growing crops on the intervening strips, and to cultivate after harvest with some implement that leaves the surface rough.

CORN AND SORGHUM

By far the largest acreage of cultivated row crops in the northern Plains is planted to corn, but some sorghum is also grown. Both crops are grown under similar conditions, have somewhat the same growing period, and are largely used as feed on the farm.

Both corn and sorghum are planted with surface planters as well as in lister furrows. There is usually more blowing after surface planting, as the cultivation is often shallow and the soil is often dry when cultivated, especially at the last time over, so that the surface soil is easily pulverized and in condition to blow. With lister planting, there is less danger of blowing, as the surface is rougher.

When most or all of these crops can be left standing on the field, there is little danger of soil blowing. This can be done with corn when it is husked in the field if the stalks are not grazed too closely. Removal of the stalks of corn or sorghum for silage or bundle feed or close grazing of standing stalks leaves an exposed surface soil that blows easily. Where there is danger of blowing, grazing should be carefully controlled so as to leave enough of the crop to protect the soil.

When corn or sorghum is harvested with a binder, it should be cut with a high stubble. Further protection can be given by cultivation, either with a lister or a shovel cultivator that will turn the roots up on the surface, where they aid in the control of blowing.

POTATOES

The acreage of potatoes is small, except in certain sections of the region, and the fields are usually also small, but, where grown, the crop leaves the soil very susceptible to drifting. When the ordinary digger is used, the soil is pulverized, and there is not enough crop residue to afford protection. Intermittent four-row strips of corn or sorghum left standing will help control wind erosion in potato fields. Deep cultivation or listing following harvest will also aid in the control of soil blowing.

ALFALFA AND SWEETCLOVER

Observations have shown that land converted from the growing of alfalfa or sweetclover to the growing of grain or row crops is extremely susceptible to blowing. This refers particularly to land where the alfalfa or sweetclover sod has been plowed or otherwise broken 1 or 2 years before the change to a different crop. The decayed roots of alfalfa and sweetclover seem to decrease soil cohesiveness and the number of clods resulting from cultivation.

There has probably been more blowing from plowed fallow in the northern Great Plains than from any other type of cultivated land. The fields are usually large, and when blowing starts on such a bare and unprotected expanse it is more difficult to control than in smaller fields.

Fallowed land, however, has some advantage over that tilled and cropped by other methods, in that the soil is usually moist when it is cultivated, which helps in forming clods. At least, there usually is moist soil near enough to the surface so that a cultivating implement such as a duckfoot or rotary-rod weeder will reach it. Dry cultivation of bare soils usually tends to pulverize the surface.

If the soil is light and tends to be sandy, there is no method of bare tillage management that will give even a reasonable assurance against drifting when conditions are favorable for it. There is very little opportunity to create or maintain a cloddy condition that will hold against wind action in this class of soil. It should be handled so as to leave a protective cover throughout the year. This can be accomplished by the stubble-mulch method of fallowing, by continuous cropping to spring grain, or by seeding to grasses and legumes.

Plowed fallow, under proper management, can be maintained with a reasonable assurance of safety on silt-loam soils and those of heavier texture throughout the northern Plains. These types of soil, as well as the sandy types, can usually be handled more safely and cheaply by stubble-mulch methods. If land is plowed, the plowing should be done fairly early in the season when there is ample moisture in the furrow slice. A certain degree of cloddiness will result, and subsequent cultivation should be such as to maintain a coarse lumpy surface. The rotary-rod weeder or shovel cultivators will usually accomplish this result. If the fallow is seeded to winter grain, the furrow drill will aid in controlling soil blowing during the winter. If fallowed land is to be seeded to spring grain, the last cultivation in the fall should develop for winter protection a ridged condition, such as is produced by the duckfoot cultivator.

STRIPCROPPING FOR WIND-EROSION CONTROL

Stripcropping for wind-erosion control (wind stripcropping) is a practice that is now widely used in sections of the northern Great Plains, particularly for small-grain crops. (See cover illustration.) In these sections it was formerly customary to summer-fallow large fields prior to planting wheat. Such large expanses of bare soil were especially vulnerable to wind erosion. Observations showed that blowing could be minimized by dividing fields into alternate strips of fallow and grain approximately at right angles to the direction of prevailing or stormwinds.

The width of the strips used for stripcropping depends on the danger and severity of blowing to be expected. The greater the danger from blowing, the narrower the strips. The Montana Agricultural Experiment Station recommends that strips should not be wider than 16 rods in order to retain the shielding effect, or narrower than 5 rods in order to make economical use of farm machinery. Even though large expanses of bare soil are avoided by stripcropping, care-

ful management and cultivation are still necessary to control blowing on fallow strips.

Crops other than small grains can be adapted for forms of strip-cropping. A crop or cultivation method that leaves the soil exposed during the winter and spring, for example, can be planted in alternate strips with vegetation that provides protection during that period.

REGRASSING

The most effective measure for the control of wind erosion on areas that are subject to severe blowing is the establishment of hardy, adapted grasses. When established, grasses not only provide surface cover but bind the soil below with a network of roots.

Several grasses are suitable for growing in the northern Great Plains. The so-called cool-season grasses are widely adapted. These include crested wheatgrass, intermediate wheatgrass, western wheatgrass, slender wheatgrass, tall wheatgrass, smooth brome, Canada wildrye, Russian wildrye, and feather bunchgrass. Warm-season grasses, including big bluestem, side-oats grama, blue grama, buffalo grass, and switchgrass, are also useful for planting within the region.

Detailed information on methods of establishing and maintaining stands of cultivated grasses can be obtained from county agents or State agricultural experiment stations within the region.

EMERGENCY CONTROL

Soil drifting usually begins in small parts of a field where the soil is less stable or more exposed than in the remainder of the field. Unless these small areas are brought under control, the drifting may increase; if the wind continues, damage will become more severe and will spread rapidly over larger areas.

Cultivation of the initial blow areas crosswise to the wind with a duckfoot, spring-tooth, or common row cultivator is usually enough to check ordinary soil movement, especially if these implements turn up moist soil or create a cloddy surface. When cultivation in strips will check drifting, it is better not to cultivate the entire surface, but to leave some of the soil uncultivated to be used for later control if necessary.

Straw or manure is effective for control in small areas, if a disk set straight or a similar implement is used immediately to force such residues into the surface soil. If left loose, they may be blown into piles or drifts and may accumulate hummocks of soil.

If an entire field starts to blow, the surface should be put in a roughened and cloddy condition as soon as possible. This cultivation should be only deep enough to accomplish the desired results, because if winds recur it may be necessary to cultivate again in order to turn up moist soil. In extreme cases where soil has been drifting for some time, or where deep cultivation is necessary, a lister may be used. This should only be done if other means fail to check drifting.

Emergency tillage is a temporary expedient to control land that has been allowed to reach a blow condition. Its object is to hold the soil in place until a plant cover can be established. Where proper land-use and management practices are followed, emergency control measures should not be needed frequently. Among the management

practices that reduce the need of emergency measures are: elimination of burning, preservation of protective amounts of residues on the surface when tilling for moisture storage or weed control, prevention of excessive grazing of row-crop stalks, and adoption of a system of cropping in which growing crops or residues cover the land during the usual time of high winds.

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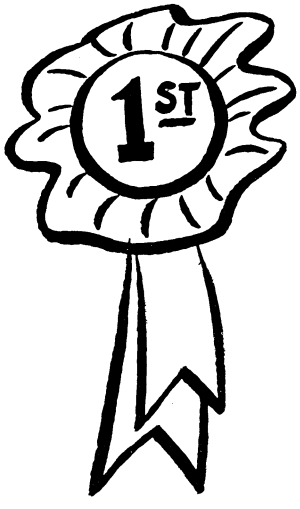

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